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(54) Title:	COILABLE ELONGATE BLASTING CARTRIDGE			
(57) Abstract				
<p>Coilable elongate explosives charge or blasting cartridge (1) comprises elongate semi rigid plastics tube (2) having end closures (4, 7), detonating cord (5) extending longitudinally within tube (2) between opposite ends, and an explosive composition occupying all but a small portion of tube (2) at the proximal end. Free end (8) can be folded to form a stem plug when inserting charge (1) into a borehole. Distal end (3) of tube (2) can also be formed with an enlarged diameter region to provide, in use, a region of increased explosive energy adjacent the butt of a borehole.</p>				

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TITLE

## COILABLE ELONGATE BLASTING CARTRIDGE

FIELD OF INVENTION

5 This invention is concerned with improvements in packaging of explosive compositions for transportation and handling.

BACKGROUND OF THE INVENTION

10 It is well known to package explosive compositions in purpose designed packages to assist in transportation and handling of explosive compositions including dry powder or granulated compounds, emulsions, slurries, water gels and the like.

These packages may be adapted to suit charge mass, borehole diameter, borehole length and the like.

15 Australian Patent Application AU-A-81802/87 describes the packaging, in non-porous plastic cartridges of from 25mm to 75mm in diameter and 1000mm long, an explosive composition comprising ammonium nitrate, paraffinic oil and foamed or expanded polystyrene beads.

20 British Patent 882665 describes the packaging of ammonium nitrate compositions in paper wrapped cartridges.

25 British Patent 1281421 also describes the packaging of an ammonium nitrate explosive in a thin flexible plastics sheath such as polyethylene. This product has a detonating cord extending throughout an elongate explosive filled sheath in a unitary charge up to 20m long. The specification discloses divisible charges in rolls of from 50m to 100m in length whereby charges of selected shorter length can be formed by clamping the sheath at closely spaced intervals and severing the charge therebetween.

30 The patent specification states that explosive charges according to the invention can be inserted into boreholes at up to 60° from vertical and

moreover that with the aid of a bracket shaped slide, these packages can be inserted into horizontal boreholes.

Experience has shown however that thin flexible sheaths of say 0.2mm in wall thickness are prone to perforation by puncture on rough borehole surfaces or by abrasion even on smooth borehole surfaces. If such perforations occur near the lower end of the charge being inserted, there is a risk that a substantial part of the freely flowing particulate explosive composition would fall to the bottom of the borehole beyond the end of the detonating cord without the knowledge of the personnel concerned. Only when the connected charges in adjacent boreholes were detonated would it be discovered that the mechanical and safety aspects of the integrated breaking pattern were comprised by the detonation failures in one or more boreholes.

These soft thin walled explosive packages were found to be difficult and time consuming to insert into horizontal boreholes and even more prone to puncture and tearing when pushed into the horizontal cavity.

A particular difficulty with such flexible, thin walled elongate explosive charges is that when rolled into conveniently sized coils for packaging, transportation and storage, the tubular sheath is prone to kinking or flattening in parts.

At the position of the kink or flattened region, the cross-sectional area of the explosive charge is substantially diminished and with severe kinking, a discontinuity may be formed in the mass of explosive material. This kinking or cross sectional area reduction can also occur when trying to insert elongate thin walled flexible tubular explosive charges into inclined or horizontal boreholes.

It is believed that severe reductions in cross sectional area or discontinuity in the mass of explosive composition may give rise to a condition known as "gapping" where propagation of explosive energy along the charge column is interrupted.

In order to overcome such problems with prior art packaged

explosives, particularly for use in perimeter hole blasting for tunnel shaping where the boreholes are horizontally drilled, it has been proposed to use short, rigid tubular packages adapted for end to end coupling to form a long unitary charge.

5 Originally such explosive packages comprised a stiff paper or cardboard cylinder about 900mm long and about 20mm diameter filled with a highly viscous, non flowable cap sensitive emulsion explosive. The paper or cardboard cylinder was open at opposite ends which were shaped to form a socket and spigot connection between adjacent 10 packages.

Of more recent times these paper or cardboard cylinders have been replaced with a semi rigid plastics tube such as polyethylene with a wall thickness of about 1mm.

15 A difficulty encountered with these prior art modular explosives tubes is that a close face to face abutment of the explosive composition in adjacent tubes is required to ensure propagation of the explosive force throughout the entire assembly which may for example comprise six tubes joined by the socket and spigot fittings.

20 As typically these tubes are initially filled with a heated mix to reduce the viscosity of the normally non-flowable viscous emulsion, the tube contents undergo shrinkage on cooling and can create a gap of 2-3mm between the faces of explosive material when the tubes are joined.

25 Where "gapping" occurs between adjacent explosive masses, whether due to shrinkage in the tube or human error in assembly, an incomplete explosion can leave one or more portions of the explosive charge in the ground. This is an extremely hazardous situation with cap sensitive explosives in particular which may be accidentally detonated by impact from an excavator or subsequently in a crushing mill.

30 Another problem associated with prior art blasting techniques is that where it is required to increase the powder factor or energy factor in the butt" or base of a borehole, it is common practice to first push a

separate primer charge to the butt of the borehole.

Thereafter, a water gel or emulsion explosive is loaded into the borehole, typically in the form of spigot and socket joined tubes described above.

5 Again this procedure is prone to unreliability due to gapping between the primer and the end of the explosive charge and/or between adjacent tubes which can lead to ineffectual blasting, rifling of the borehole and unexploded explosives left in the borehole.

10 Yet another disadvantage associated with the abovementioned prior art explosive charges is the need to insert a stem plug to close off the borehole after the charge is loaded.

This is a costly and time consuming process.

#### SUMMARY OF THE INVENTION

15 It is an aim of the present invention to overcome or ameliorate at least some of the prior art problems associated with explosives packaged in tubular containers and/or otherwise to provide users with a convenient choice.

20 According to one aspect of the invention there is provided an explosive charge comprising:-

an elongate semi rigid plastics tube having a closure at each end, a detonating cord extending longitudinally within the tube between opposite ends thereof, and an explosive composition occupying the interior of said tube.

25 If required, the semi rigid tube is selected from a stiffness range to permit easy insertion of the charge into horizontal or upwardly inclined boreholes.

30 Suitably said semi rigid tube, in use, permits formation of said charge into a coil having an inner diameter of 200mm or greater without kinking.

Suitably said semi rigid plastics tube has a wall thickness in the

range of from  $300\mu$  to  $1500\mu$ .

Most preferably the semi rigid tube has a wall thickness of  $800\mu$  to  $1200\mu$ .

5 If required the semi rigid tube may be formed with smooth exterior and interior walls.

The semi rigid tube may be formed with a corrugated wall to facilitate coiling of a charge.

Suitably the semi rigid tube has an external diameter in the range 10mm to 50mm.

10 Preferably the semi rigid tube has an external diameter of from 18mm to 25mm.

If required, the charge may comprise an enlarged end portion having a diameter 20% to 100% greater than the diameter of the tube.

15 The enlarged end portion preferably comprises a diameter 50% greater than the diameter of the tube.

The enlarged end portion may have an axial length in the range 100mm to 1000mm.

20 Preferably the enlarged end portion has an axial length in the range 200mm to 500mm.

If required the enlarged end portion may be integrally formed with the semi rigid tube.

Alternatively the enlarged end portion may be removably attachable to said semi rigid tube.

25 The explosive composition may be selected from flowable particulate materials, water gels or emulsions.

The explosive composition may be cap sensitive.

The tube may be sealed at opposite ends by any suitable means.

Preferably a normally distal end of the charge is sealed with a bung having a sealed cap well.

30 Most preferably a proximal end of the charge includes a free end of said tube to enable, in use, the free end to be folded over to form a

stemming plug.

Suitably the packing density of the explosive composition is greater than 1.0 gm cm<sup>-3</sup>.

According to another aspect of the invention there is provided a 5 first method of manufacturing a coilable elongate explosive charge, said method comprising the steps of:-

inserting a detonator cord through a predetermined length of semi rigid plastics tube;

10 securing a distal end of said detonator cord to a closure member and inserting said closure member into a distal end of said tube;

suspending said tube from a proximal end from a filling station;

20 progressively filling said tube with a flowable particulate explosive composition; and,

15 sealing said proximal end of said tube with at least portion of said detonating cord extending therefrom.

Preferably said tube is suspended from a vibratory suspension means.

Suitably a free end of the tube extends beyond a proximal seal, to enable folding of the proximal free end, in use, to form a stem plug.

20 According to a further aspect of the invention there is provided a second method of manufacturing a coilable elongate explosive charge, said method comprising the steps of:-

supporting on a hollow mandrel a predetermined length of semi rigid plastics tube having a closed distal end;

25 pumping a fluid explosive composition into said tube via said hollow mandrel to progressively displace said tube along said tube with a predetermined quantity of explosive composition; and

forming a closure in a proximal end of said tube.

If required said distal end may be closed with a closure means 30 having a sealed cap well.

The semi rigid plastics tube may include a detonating cord

extending internally over the length of the tube.

#### BRIEF DESCRIPTION OF DRAWINGS

5 In order that the invention may be more readily understood and put into practical effect, the invention will now be described with reference to preferred embodiments illustrated in the accompanying drawings in which:-

FIG 1 shows a coilable elongate explosive charge.

10 FIG 2 shows a closure member for use in the charge of FIG 1.

FIG 3 shows an alternative embodiment of the invention.

15 FIG 4 shows schematically one method of filling a coilable explosive charge.

FIG 5 shows schematically another method of filling a coilable explosive charge.

15

#### DETAILED DESCRIPTION

In FIG 1 the explosive charge 1 comprises a 4.5m length of low or medium density polyethylene tube 2 having a wall thickness of 1.0mm.

20 The tube 2 is sealed at its distal end 3 with a rubber, plastics or timber bung 4 to which is attached one end of a length of detonator cord 5.

25 Detonator cord 5 extends throughout the axial length of tube 2 and a free end 6 extends through a closure 7 at the proximal end of the tube 2. The closure 7 is conveniently a "Tipper Tie" in the form of a metal clip extending tightly around the tube 2 to form a waterproof seal.

A particulate explosive composition which may comprise for example 90% ammonium nitrate (finely ground), 6-8% of a particulate carbonaceous fuel such as a coal dust, and 2-4% of a sensitizer such as aluminium powder, perchlorate etc.

30 It is to be understood that the present invention is not limited to any particular explosive composition and may comprise any known flowable

particulate explosive, water gels and emulsions.

It is to be further understood that as used herein to distinguish the opposite ends of coilable semi rigid tubular explosive charges, "distal" means the remote end of the charge, in use, closest the butt of the borehole and "proximal" means the end of the charge opposite the distal end.

The detonator cord as described above may be selected from 5gm cord for general applications or up to 10 gm cord for harder earth formations.

Typically, charges of the type described above will be used in perimeter hole blasting where horizontal boreholes are drilled for tunnel shaping etc.

The charges used for perimeter hole blasting typically are from 2 to 5 metres long but often in the range 3-4 metres.

The boreholes are usually spaced at 750-800mm from each other and may be 30-50mm in diameter.

As shown in FIG 1, a free end 8 of the tube extends beyond closure 7 for about 400mm in length. This enables the proximal free end, in use, to be folded over upon itself to form a stem plug when inserting the charge into a borehole thereby alleviating the costs associated with insertion of a separate stem plug as required with prior art charges of this type.

FIG 2 shows a preferred form of distal end closure in the form of a plastics bung 9 having a cylindrical body 10 and an end flange 11.

Apertures 12 extend through the bung 9, the purpose of which will be described later.

Also located in bung 9 is a blind bore or cap well 13 adapted to receive a detonator (not shown) but otherwise to provide a waterproof closure for use in water filled boreholes.

FIG 3 shows the bung of FIG 2 fitted to an alternative embodiment of the invention.

In this embodiment, the distal end 14 of tube 15 is radially increased from say 20mm to about 35mm over an axial length of from 100mm to 600mm to provide a charge region of increased powder or energy factor at the base or butt of a borehole.

5 The increased radial volume may accommodate an explosive composition having a higher explosive energy than that in tube 15 but preferably contains the same composition throughout the axial length of the charge.

10 In assembly of the charge, a detonator cord 16 is extended through the length of tube 15 and through one of apertures 12 and then the free end 17 of the detonator cord is inserted back through the other of apertures 12 to securely locate the cord 16 in the charge.

15 Bung 9 is then secured to the distal end 14 to tube 15 by heat sealing, adhesive or mechanical clamping means (not shown) before the explosive composition is inserted into the tube.

FIG 3 shows a method of manufacture of a coearable explosive charge having a flowable particulate explosive composition.

20 In FIG 3, a 4m length of 20mm diameter polyethylene tubing 20 first has a detonator cord 21 (shown in phantom) inserted and secured in the distal end thereof by means of a bung 22 as generally shown in FIG 2.

Tube 20 is then suspended by its proximal end in a clamping gland 23 in filling station 24 with the neck 25 of a filling hopper 26 inserted into the open end of tube 20.

25 Valve 27 is opened and the filling station 24, mounted on resilient mounts 28 is vibrated by a mechanical or electromechanical vibrator 29 to assist in filling the tube with a flowable particulate explosive composition 30 from hopper 26.

30 Vibration is important during the filling operation to not only reduce filling time but also to ensure an even packing density of the particulate explosive composition over the entire length of tube 20.

A packing density greater than 1.0 gm cm<sup>-3</sup> is desirable to ensure

that the charge will not float in a water filled borehole.

When the tube 20 has been filled to a distance of about 400mm from the proximal end of the tube, valve 27 is closed and a "Tipper Tie" (Trade Mark) closure is secured around the tube 20 at the upper level of the explosive composition to form a waterproof closure about the free end of detonator cord 21 which extends from the closure.

Gland 23 is released and the tubular charge drops onto an arcuate guideway (not shown) leading on to a horizontal inspection and packing table (not shown).

10 The tubular charge is wound onto a mandrel of from 200-250mm diameter to form a coil having an external diameter of about 450mm which is secured with a tie or adhesive tape to prevent unravelling.

Coiled charges are then packed in boxes in multiples of four to eight for safe transport.

15 It will be readily apparent to a skilled addressee that the above method enables custom manufacture of tubular charges to any required length without any change in apparatus set up or procedures.

FIG 5 shows an alternative embodiment of the manufacturing process utilising a liquid or paste-like water gel or emulsion explosive.

20 In this embodiment a slurry pump 30 such as a "Mono" (Trade Mark) is coupled to a four metre long hollow mandrel 31 over which a hollow semi-rigid tube 32 is closely fitted.

25 The distal end of tube 32 is fitted with an enlarged end 33 which may be integrally formed by thermo-forming or it may be a moulded hollow body attachable to tube 32 by heat sealing, adhesive, threaded connection or the like.

A detonating cord 34 extends from a reel 35 over an idler 36 and into mandrel 31 at the base of pump 30 via a gland 37 and is connected to bung closure 38 in a manner as described with reference to FIG 3.

30 A liquid or paste-like explosive composition 39 is then pumped under pressure into the distal end of tube 32 and as the interior fills, tube

32 is progressively displaced along the mandrel 31 and on to inspection and packing table 40.

Again, when the explosive composition occupies all but about the last 400mm of the proximal end of the tube 32, pump 30 is stopped and a 5 "Tipper Tie" (Trade Mark) or similar clamp is applied to the tube 32 by a clamping head 41 to form a waterproof closure about detonator cord 34 extending therefrom with an open "tail" above the closure.

After severing the detonator cord 34 and tube 32 at required positions, the process is repeated and again, it will be readily apparent to 10 a skilled addressee that this process is readily adapted to produce explosive charges of any required length.

In the various aspects referred to above, the semi-rigid tube may 15 be comprised of any suitable material such as plastics or rubbers including poly vinyl chloride, polyethylene, polypropylene butyl rubber or any other homopolymeric or copolymeric materials suited for the intended purpose.

While it is important that the tubular explosives charges according 20 to the invention are not so flexible that they cannot readily be loaded into inclined or horizontal boreholes, it is equally important that they be not so stiff that they cannot be coiled without kinking into conveniently sized packages for storage, transport and handling.

The requisite properties of the semi-rigid tube may be modified by 25 using a thinner wall with a more rigid polymer or vice versa. Similarly, increased rigidity may be imparted to an otherwise too flexible tube by incorporation of elongate ribs in the wall during manufacture by, say, extrusion.

It is preferred however that the outer wall has a smooth surface to 30 assist in insertion in boreholes. For the dry powder explosives compositions described with reference to FIG 4, it is preferred that the interior wall has a smooth surface to avoid interference with packing of the particulate composition.

In the coiling of the elongate tubular explosive charges, it is important that the stiffness or rigidity of the tube is such that when coiled, the tube does not kink to form a reduction in cross sectional area or even a discontinuity in the mass of explosive composition as this may create a 5 situation analogous with gapping as in prior art systems.

It is equally important that when the charge is uncoiled, there is sufficient resilient recovery that the tubular charge readily assumes a substantially straight configuration to assist in insertion in boreholes.

In the practice of the present invention, it has been found that a 10 low-medium density polyethylene tube having an external diameter of 20-21mm and a wall thickness of 1mm can be coiled over a 200mm winding mandrel without kinking and stored for long periods of time without developing a permanent set which resists elastic recovery to a generally straight elongate tube.

CLAIMS

1. An explosive charge comprising:-  
an elongate semi rigid plastics tube having a closure at each end, a detonating cord extending longitudinally within the tube between opposite ends thereof, and an explosive composition occupying a substantial volume of the interior of said tube, said tube having an enlarged distal end portion with a diameter 20% to 100% greater than the diameter of the tube.
2. An explosive charge as claimed in claim 1 wherein the enlarged end portion with a diameter 50% greater than the diameter of the tube.
3. An explosive charge as claimed in claim 1 or claim 2 wherein the enlarged end portion has an axial length in the range 100mm to 1000mm.
4. An explosive charge as claimed in claim 3 wherein the enlarged end portion has an axial length in the range 200mm to 500mm.
5. An explosive charge as claimed in any one of claims 1 to 4 wherein the enlarged end portion is integrally formed with the semi rigid tube.
6. An explosive charge as claimed in any one of claims 1 to 4 wherein the enlarged end portion is attachable to said semi rigid tube.
7. An explosive charge as claimed in any preceding claim wherein the semi rigid tube is selected from a stiffness range to permit easy insertion of the charge into horizontal or upwardly inclined boreholes.
8. An explosive charge as claimed in any preceding claim wherein said semi rigid tube, in use, permits formation of said charge into a coil having an inner diameter of 200mm or greater without kinking.
9. An explosive charge as claimed in any preceding claim wherein the semi rigid tube is formed with a smooth exterior wall.
10. An explosive charge as claimed in any one of claims 1 to 8 wherein the semi rigid tube is formed with a corrugated wall to facilitate coiling of a charge.
- 30 11. An explosive charge as claimed in any preceding claim wherein the semi rigid tube has an external diameter in the range 10mm to 50mm.

12. An explosive charge as claimed in claim 11 wherein the semi rigid tube has an external diameter of from 18mm to 25mm.
13. An explosive charge as claimed in any preceding claim wherein said semi rigid plastics tube has a wall thickness in the range of from 5  $300\mu$  to  $1500\mu$ .
14. An explosive charge as claimed in claim 13 wherein the semi rigid tube has a wall thickness of  $800\mu$  to  $1200\mu$ .
15. An explosive charge as claimed in any preceding claim wherein the explosive composition is selected from flowable particulate material, water gels or emulsions. 10
16. An explosive charge composition as claimed in any preceding claim wherein the explosive composition is cap sensitive.
17. An explosive composition as claimed in any preceding claim wherein the tube is sealed at opposite ends.
- 15 18. An explosive composition as claimed in any preceding claim wherein a distal end of the charge is sealed with a bung having a sealed cap well.
19. An explosive composition as claimed in any preceding claim wherein a proximal end of the charge comprises a free tail of said tube to enable, in use, the proximal free end to be folded over to form a stemming 20 plug.
20. An explosive composition as claimed in any preceding claim wherein the packing density of the explosive composition is greater than 1.0 gm  $\text{cm}^{-3}$ .
- 25 21. A method of manufacturing a coillable elongate explosive charge as claimed in any one of claims 1 to 20, said method comprising the steps of:-
  - inserting a detonator cord through a predetermined length of semi rigid plastics tube;
  - securing a distal end of said detonator cord to a closure member and inserting said closure member into a distal end of said tube; 30

suspending said tube from a proximal end from a filling station; progressively filling said tube with a flowable particulate explosive composition; and,

5 sealing adjacent said proximal end of said tube with at least portion of said detonating cord extending therefrom.

22. A method as claimed in claim 21 wherein said tube is suspended from a vibratory suspension means.

23. A method as claimed in claim 21 or claim 22 wherein portion of the proximal end of the tube is left as a free tail, to enable folding of the free proximal tail, in use, to form a stem plug.

10 24. A method of manufacturing a coearable elongate explosive charge, said method comprising the steps of:-

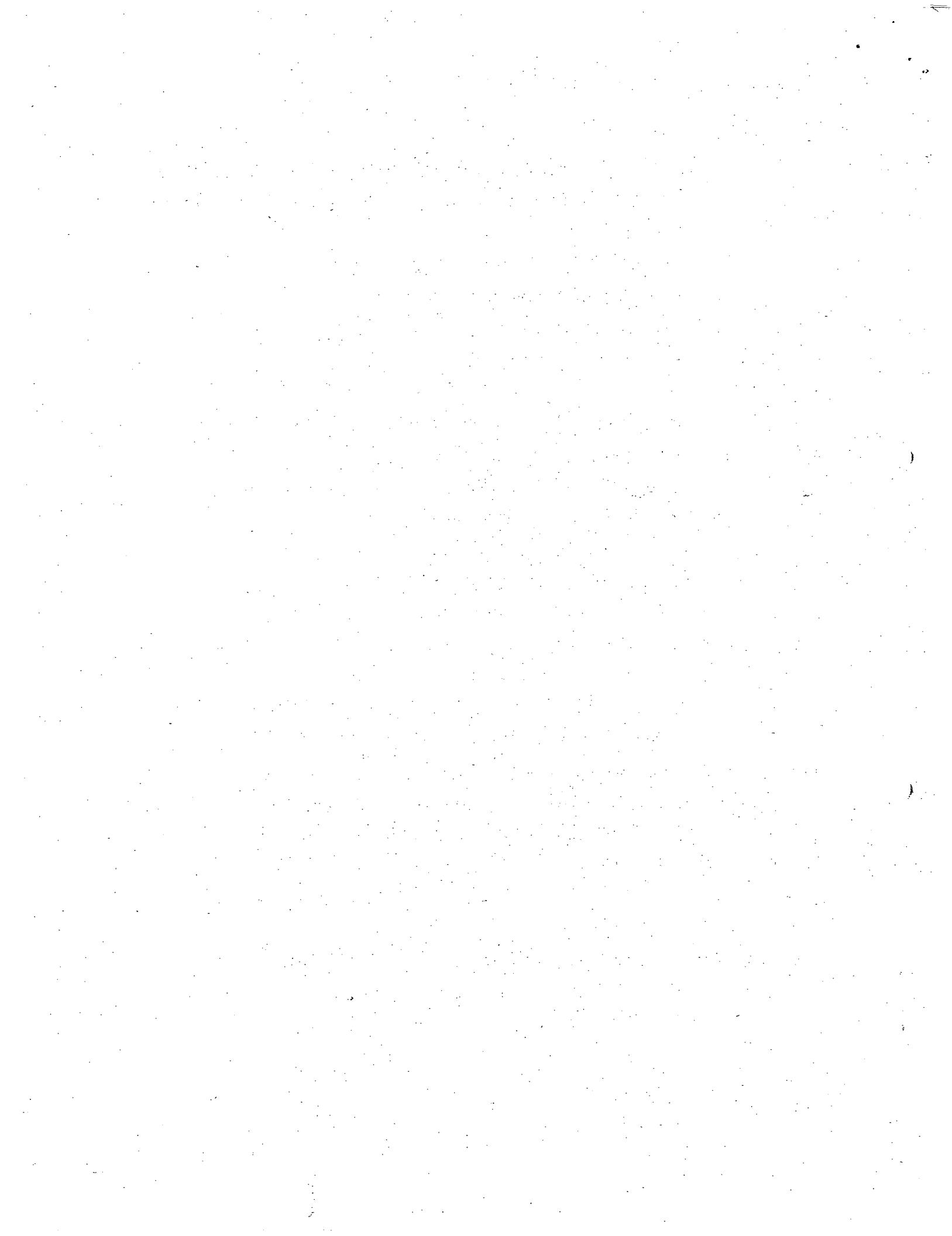
supporting on a hollow mandrel a predetermined length of semi rigid plastics tube having a closed distal end;

15 pumping a fluid explosive composition into said tube via said hollow mandrel to progressively displace said tube along said tube with a predetermined quantity of explosive composition; and

forming a closure adjacent a proximal end of said tube.

25. A method as claimed in claim 24 wherein said distal end is closed with a closure means having a sealed cap well.

20 26. A method as claimed in claim 24 or claim 25 wherein the semi rigid plastics tube includes a detonating cord extending internally over the length of the tube.



1 / 4

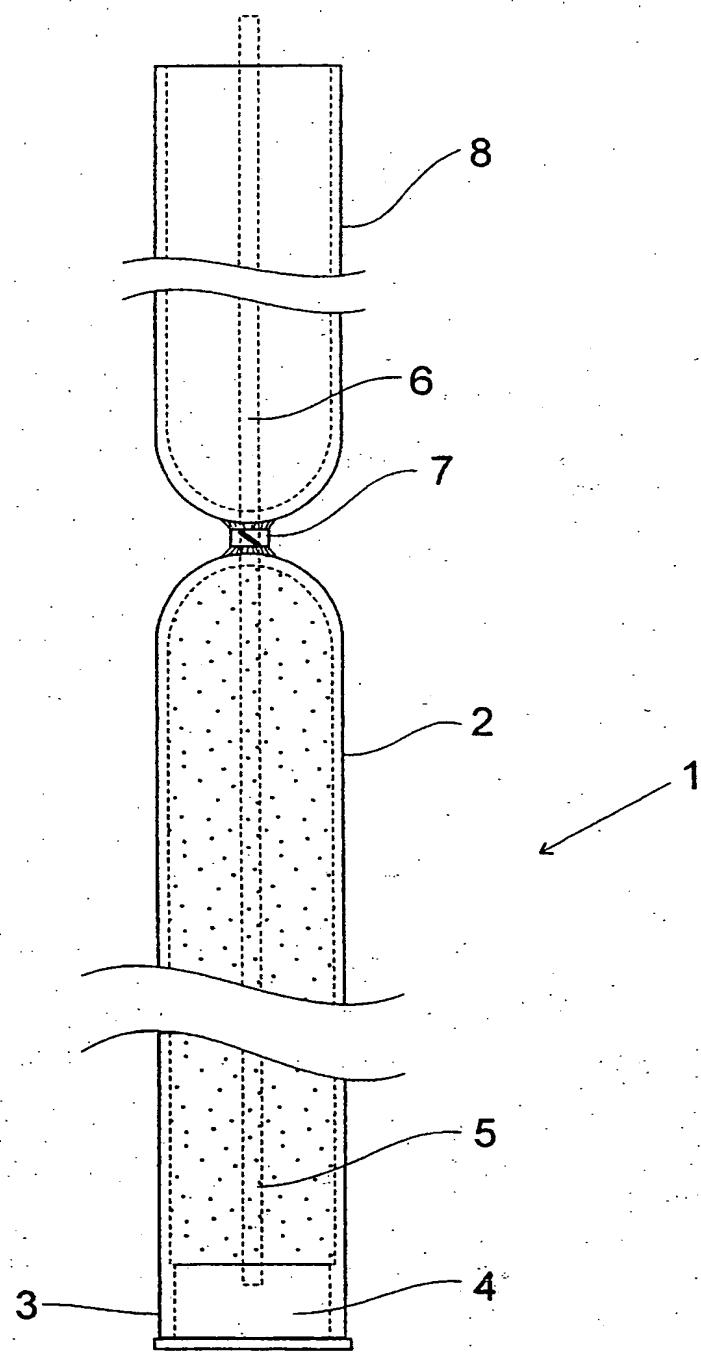


FIG. 1



2 / 4

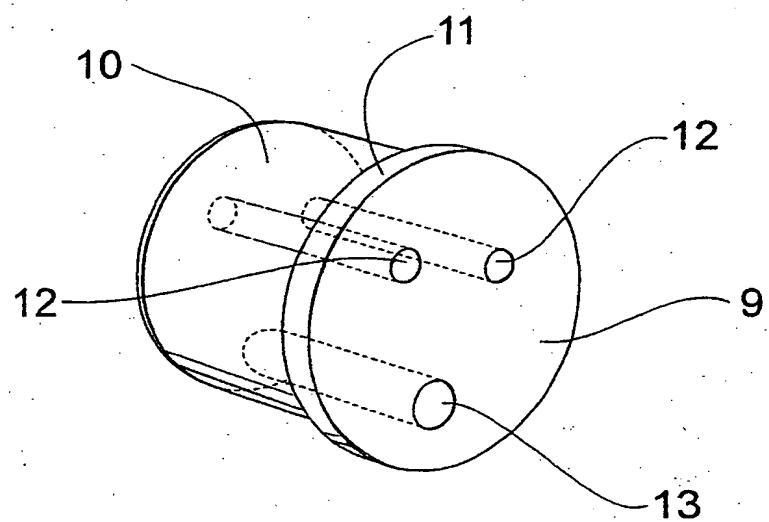


FIG. 2

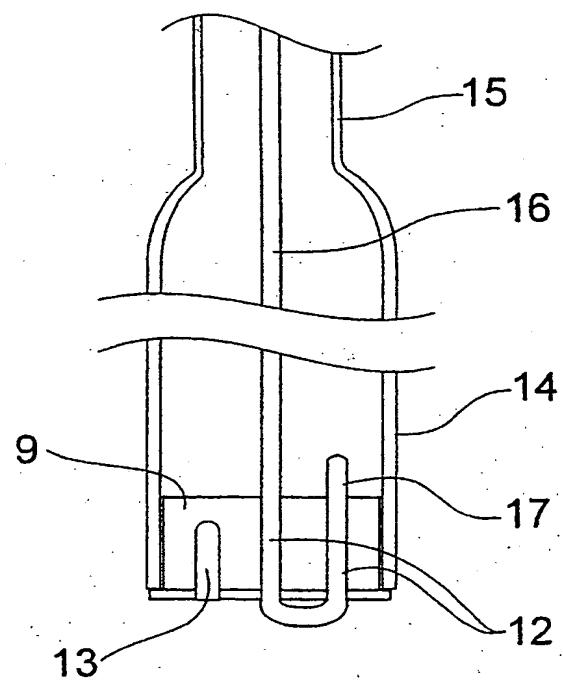


FIG. 3



3 / 4

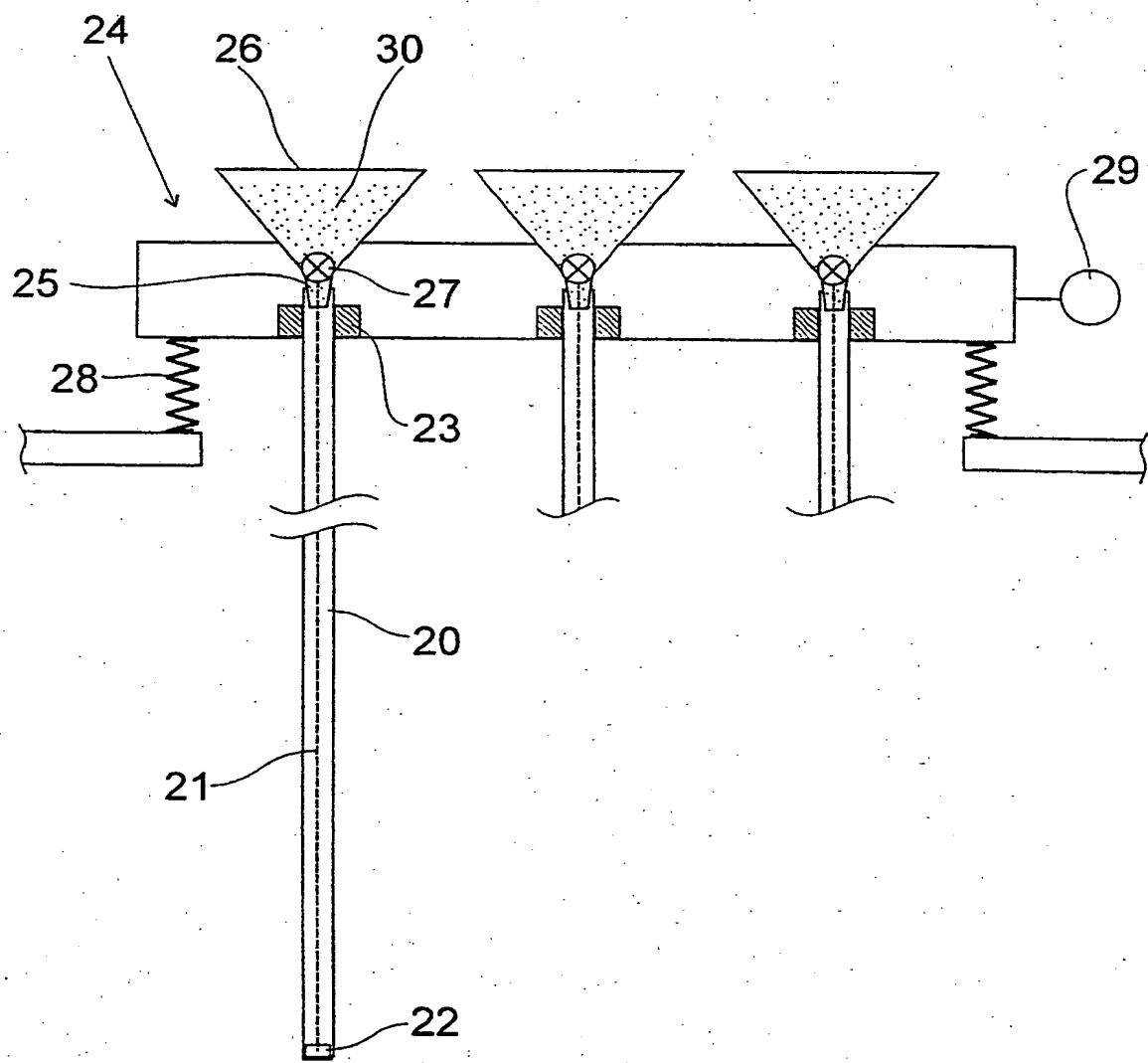


FIG. 4



4 / 4

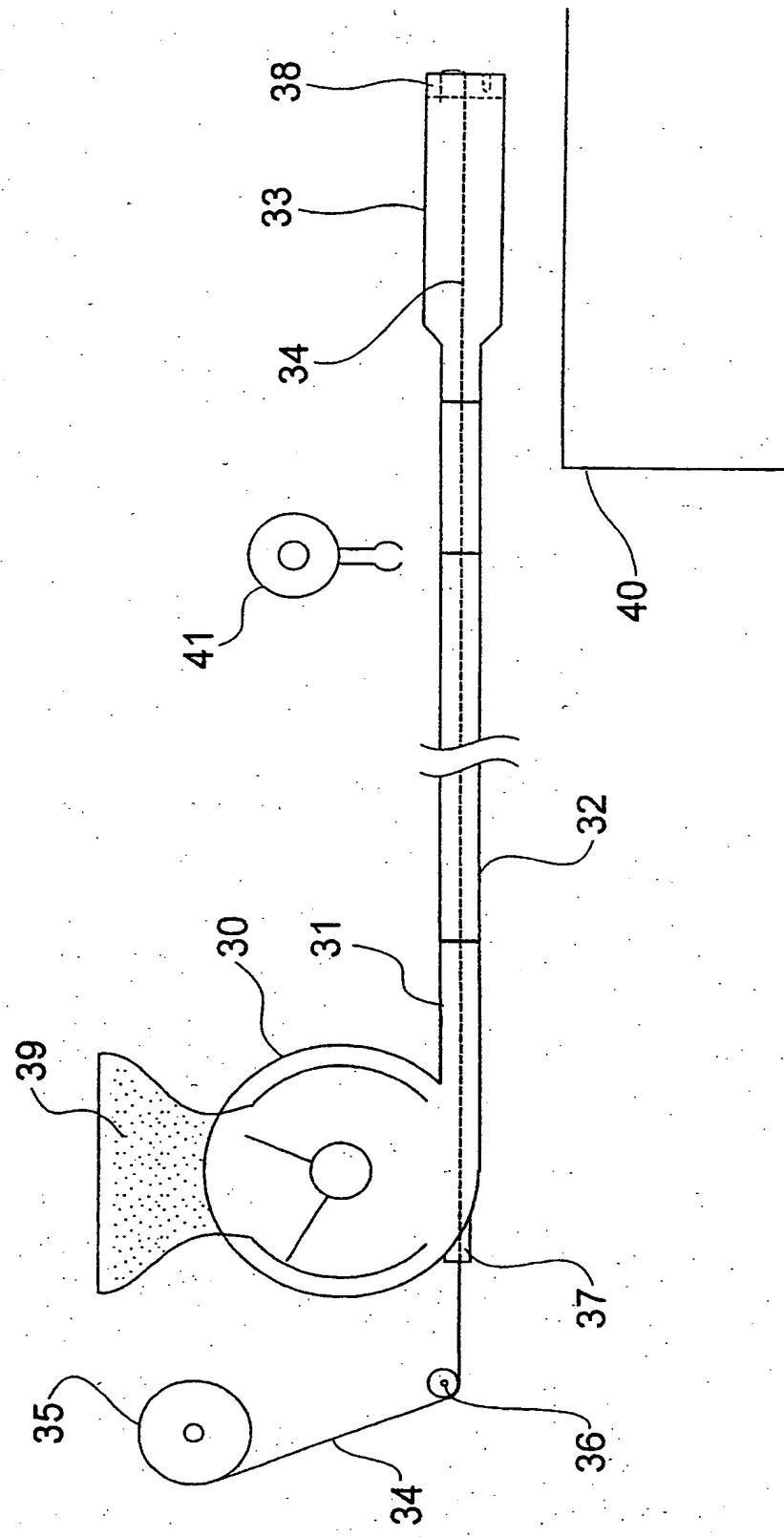


FIG. 5



## INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU 99/00134

<b>A. CLASSIFICATION OF SUBJECT MATTER</b>		
Int Cl <sup>6</sup> : F42B 3/087, 3/28		
According to International Patent Classification (IPC) or to both national classification and IPC		
<b>B. FIELDS SEARCHED</b>		
Minimum documentation searched (classification system followed by classification symbols) IPC: F42B 3/00, 3/087, 3/28		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched AU : IPC as above		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) WPAT with keywords		
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3949673 A (LYERLY) 13 April 1976	24,25
A	Whole document	1-23,26
X	AU 21624/77 (499047) B (AECI LIMITED) 3 August 1978 Pages 9-10	24,25
A	AU 10705/92 A (SPECIALISED POLYURETHANE APPLICATIONS PTY LTD) 6 August 1982	
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Date of the actual completion of the international search 23 March 1999	Date of mailing of the international search report - 1 APR 1999	
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200 WODEN ACT 2606 AUSTRALIA Facsimile No.: (02) 6285 3929	Authorized officer  JEFFREY CARL Telephone No.: (02) 6283 2543	

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU 99/00134

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	AU 33390/84 A (DYNAMIT NOBEL AG) 28 March 1985	

**INTERNATIONAL SEARCH REPORT**

International application No.

PCT/AU 99/00134

**Box II continued**

The international application does not comply with the requirements of unity of invention because it does not relate to one invention or to a group of inventions so linked as to form a single general inventive concept. In coming to this conclusion the International Searching Authority has found that there are different inventions as follows:

1. Claims 1-23 are directed to an explosive charge and a method of manufacturing the explosive charge wherein the charge includes a detonating cord and an enlarged distal end. It is considered that the combination of the detonating cord and the enlarged distal end comprises a first "special technical feature".
2. Claims 24-26 are directed to a method of manufacturing an explosive charge which does not include the feature of the enlarged distal end and which may or may-not include a detonating cord. It is considered that the absence of the enlarged distal end and the optional inclusion of the detonating cord comprises a second "special technical feature".

The feature common to all of the claims is an explosive charge including an elongate semi rigid plastics tube filled with an explosive composition. However this common feature is generic in the art and is acknowledged as such in the description of the prior art at page 3, lines 11-13 of the present application. Consequently the common feature does not constitute "a special technical feature" within the meaning of PCT Rule 13.2, second sentence, since it makes no contribution over the prior art. Since there exists no other common feature which can be considered as a special technical feature within the meaning of PCT Rule 13.2, second sentence, no technical relationship within the meaning of PCT Rule 13 between the different inventions can be seen. Consequently it appears that a posteriori, the claims do not satisfy the requirement of unity of invention.

However since all these inventions share the same classification under the IPC they could be searched together without effort which would warrant an additional fee.

## INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/AU 99/00134

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report			Patent Family Member			
US	3949673	BR	7502289	CA	1062542	
AU	21624/77	GB	1550234	NZ	183189	ZA 7600659
AU	10705/92	CA	2060610	US	5198613	
AU	33390/84	DE	3334464	EP	150259	US 4593622

END OF ANNEX